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10/789,793	02/27/2004	Hung-Yi Huang	67,200-1215	9430

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EXAMINER

VAN, LUAN V

ART UNIT PAPER NUMBER

1753

DATE MAILED: 05/15/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/789,793

Applicant(s)

HUANG, HUNG-YI

Examiner

Luan V. Van

Art Unit

1753

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 15 April 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-19 and 25-29 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-19 and 25-29 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

Applicant's amendment of April 15, 2006 does not render the application allowable.

The amendment is objected to under 35 U.S.C. 132(a) because it introduces new matter into the disclosure. 35 U.S.C. 132(a) states that no amendment shall introduce new matter into the disclosure of the invention. The added material which is not supported by the original disclosure is as follows: Claims 1-19 and 25-29 are amended to recite the limitations of "wherein said shield is vertically adjustably movable during an electroplating process", "plate shaped ring body" and "the cathode and wafer are rotatable". However, there is no evidence in the applicant's disclosure to support these limitations. For example, the disclosure discloses that the shield can be moved closer to the contact ring (paragraph 54) but does not disclose that this is performed during an electroplating process. The disclosure also does not explicitly teach a plate-shaped ring body nor that the cathode and wafer are rotatable. The disclosure, therefore, does not provide a clear indication to support the newly added limitations. Applicant is required to cancel the new matter in the reply to this Office Action.

Status of Objections and Rejections

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The rejection of claims 20-24 is obviated by Applicant's cancellation.

All rejections from the previous office action are withdrawn in view of Applicant's amendment.

New grounds of rejection under 35 U.S.C. 103(a) are necessitated by the amendments.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 1-19 and 25-29 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Claims 1-19 and 25-29 are amended to recite the limitations of "wherein said shield is vertically adjustably movable during an electroplating process", "plate shaped ring body" and "the cathode and wafer are rotatable". However, there is no evidence in the applicant's disclosure to support these limitations. For example, the disclosure discloses that the shield can be moved closer to the contact ring (paragraph 54) but does not disclose that this is performed during an electroplating process. The disclosure also does not explicitly teach plate

shaped ring body nor that the cathode and wafer are rotatable. The disclosure, therefore, does not provide a clear indication to support the newly added limitations.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claims 1-4, 6-9, 11-15, 18, 19, 25 and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ueno in view of Mayer et al.

Regarding claims 1 and 7, Ueno teaches an electroplating apparatus comprising: a reservoir 1 for holding an electrolyte fluid (figure 2) comprising metal ions for electroplating; an anode 4 and a cathode 7, said cathode for holding a wafer 6 provided in said reservoir 1; an electrical pathway 8 provided between said cathode and said

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anode; and a shield or auxiliary electrode 12 comprising a generally plate-shaped or disk (column 6 lines 16-18) shield body provided between said cathode and said anode.

With respect to increasing a plated metal thickness uniformity, since the prior art structure is capable of performing the intended use as recited in the preamble, then it meets the claim. See, e.g., *In re Schreiber*, 128 F.3d 1473, 1477, 44 USPQ2d 1429, 1431 (Fed. Cir. 1997).

Ueno differs from the instant claims in that the reference teach using a plate-shaped or disk (column 6 lines 16-18) shield body provided between said cathode and said anode but does not explicitly disclose the shield is vertically movable (claims 1 and 7) nor ring-shaped (claim 7), although Ueno teaches that "The size and shape of the auxiliary electrode, the curve of the wafer opposing surface, and the like may be determined as appropriate so that uniform current densities and uniform electric lines of force are created on the wafer surface, and may be set as appropriate in accordance with the characteristics of the plating apparatus. The auxiliary electrode is not limited to those disks having holes as employed in the foregoing embodiments, and may use various materials such as mesh-like ones. A disk used as the auxiliary electrode is not necessarily provided with the holes for letting the plating solution therethrough" (column 6 lines 6-23).

Nevertheless, Mayer et al. teach an electrochemical reactor is used to electrofill damascene architecture for integrated circuits (see Abstract). A shield is used to screen the applied field during electroplating operations to compensate for potential drop along the radius of a wafer. The shield establishes an inverse potential drop in the electrolytic

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fluid to overcome the resistance of a thin film seed layer of copper on the wafer.

Furthermore, Mayer et al. teach the shield can have many forms. A mechanical iris may be used to change the size of the aperture or a strip having different sizes of apertures may be shifted to vary the size of aperture that is aligned with the wafer. The shield may be raised and lowered to vary a distance that separates the shield from the wafer. The wafer or the shield may be rotated to average field inconsistencies that are presented to the wafer. The shield may have a wedge shape that screens a portion of the wafer from an applied field as the wafer rotates. The shield may also be tilted to present more or less surface area for screening effect. (Column 4 lines 30-40).

Addressing claims 1 and 7, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the shield of Ueno by using the vertically movable shield of Mayer et al., because the potential drop along the radial vector changes with time as the copper plating on the wafer increases in thickness (column 5 lines 60-63), thus vertically moving the shield during electroplating enhances plating uniformity by compensating for the potential changes.

Addressing claims 2 and 7, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the shield of Ueno to a ring-shaped shield of Mayer et al., because a ring-shaped shield helps to provide uniform current densities on the wafer surface, thus enhancing uniform electroplating and electrofilling of metallization or wiring layers for integrated circuit (column 4 lines 6-18 of Mayer et al.).

Regarding claim 3-4, 8-9 and 14-15, Ueno teaches an electroplating apparatus and method comprising of a copper shield (column 6 lines 21-23), which inherently is electrically conductive and is inherently provided on an outer surface. The shield of Ueno is structurally capable of providing a source of metal ions because it is made of copper which is the same material as that of the instant claim.

Regarding claims 6, 11 and 18, the difference between the reference to Ueno and the instant claims is that the reference teaches a conductive shield but does not explicitly teach an electrically nonconductive shield. Mayer et al. teaches that a shield is preferably made of an electrically nonconductive material, because it is resistant to the acid bath (column 5 lines 41-49).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the apparatus and method of Ueno by using the shield comprising of an electrically nonconductive material as taught by Mayer et al., because an electrically nonconductive shield would be resistant to the plating bath.

Regarding claim 12, Ueno teaches a method of electroplating a metal on a wafer comprising: providing a reservoir 1 containing an electrolyte fluid in figure 2; providing an anode 4 and a cathode 6 in said reservoir; providing an electrical pathway 8 between said cathode and said anode; providing a shield or auxiliary electrode¹² in said electrolyte fluid between said cathode and said anode; and applying a current to said cathode and said anode.

Ueno differs from the instant claims in that the reference teach using a plate-shaped or disk (column 6 lines 16-18) shield body provided between said cathode and

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said anode but does not explicitly disclose the shield is vertically movable (claim 12) nor ring-shaped (claim 12), although Ueno teaches that "The size and shape of the auxiliary electrode, the curve of the wafer opposing surface, and the like may be determined as appropriate so that uniform current densities and uniform electric lines of force are created on the wafer surface, and may be set as appropriate in accordance with the characteristics of the plating apparatus. The auxiliary electrode is not limited to those disks having holes as employed in the foregoing embodiments, and may use various materials such as mesh-like ones. A disk used as the auxiliary electrode is not necessarily provided with the holes for letting the plating solution therethrough" (column 6 lines 6-23).

Mayer et al. teach the apparatus and method as described above.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Ueno by vertically moving the shield as taught by Mayer et al., because the potential drop along the radial vector changes with time as the copper plating on the wafer increases in thickness (column 5 lines 60-63), thus vertically moving the shield during electroplating enhances plating uniformity by compensating for the potential changes.

Addressing claims 13, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the shield of Ueno to a ring-shaped shield of Mayer et al., because a ring-shaped shield helps to provide uniform current densities on the wafer surface, thus enhancing uniform electroplating and

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electrofilling of metallization or wiring layers for integrated circuit (column 4 lines 6-18 of Mayer et al.).

Regarding claims 19, 25 and 27, although Ueno is silent to the specific relative dimension of the shield and the anode of the instant claims, Ueno teach that "The size and shape of the auxiliary electrode, the curve of the wafer opposing surface, and the like may be determined as appropriate so that uniform current densities and uniform electric lines of force are created on the wafer surface, and may be set as appropriate in accordance with the characteristics of the plating apparatus. The auxiliary electrode is not limited to those disks having holes as employed in the foregoing embodiments, and may use various materials such as mesh-like ones. A disk used as the auxiliary electrode is not necessarily provided with the holes for letting the plating solution therethrough" (column 6 lines 6-23).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method and apparatus of Ueno by modifying the diameter of the shield such that it is greater than the diameter of the anode, because a skilled artisan would be able to determine the appropriate diameter of the shield such that it is greater than the diameter of the anode through routine experimentation in order to provide uniform electroplating, and because modifying the diameter of the shield such that it is greater than the diameter of the anode would allow a larger substrate to be uniformly electroplated. Furthermore, changes in shape would be a matter of design choice within the ability of one having ordinary skill (MPEP 2144.04).

Claims 5, 10, 16 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ueno in view of Mayer et al., and further in view of Cheng et al.

Ueno and Mayer et al. teach the apparatus and method as described above in addressing claim(s) 1, 7 and 12. In addition, Ueno teaches applying a positive charge to the shield to control the current densities on the wafer surface.

The difference between the reference to Ueno and the instant claims is that the reference does not explicitly teach applying a negative charge to the shield.

Cheng et al. teach applying a negative charge to the shield 40 (figure 1) to control the current densities in order to improve the thickness uniformity.

Regarding claim 5 and 10, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the apparatus of Ueno and Mayer et al. by applying a negative charge to the shield as taught by Cheng et al., because it would improve the thickness uniformity.

Regarding claim 16 and 17, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method of Ueno and Mayer et al. by applying a negative charge to the shield as taught by Cheng et al., because it would improve the thickness uniformity.

Claims 26, 28 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ueno in view of Mayer et al., and further in view of Reid et al.

Ueno and Mayer et al. teach the apparatus and method as described above in addressing claim(s) 1, 7 and 12. In addition, Mayer et al. teach that the wafer can be rotated. (Column 4 lines 30-40).

The difference between the reference to Ueno and the instant claims is that the reference does not explicitly teach that the cathode and wafer are rotatable.

Reid et al. teach using a rotatable spindle 38 which allows rotation of clamshell 33 (Fig. 3) in order to improve the thickness uniformity.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the apparatus of Ueno and Mayer et al. by using the rotatable spindle of Reid et al., because rotating the substrate would improve the electroplating thickness uniformity.

Response to Arguments

Applicant's arguments have been fully considered but they are not persuasive.

In the arguments presented on pages 8-9 of the amendment, the Applicant argues that Ueno does not disclose every limitation of the amended claims. The examiner agrees, and thus the rejections under 35 U.S.C. 102(b) have been withdrawn. New rejections under 35 U.S.C. 103(a) are therefore appropriate.

With respect to the argument on the diameter of the shield and the anode, the examiner acknowledges that Ueno is silent to the specific relative dimension of the shield and the anode of the instant claim; however, as stated in the rejection above,

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Ueno teach that "The size and shape of the auxiliary electrode, the curve of the wafer opposing surface, and the like may be determined as appropriate so that uniform current densities and uniform electric lines of force are created on the wafer surface, and may be set as appropriate in accordance with the characteristics of the plating apparatus. The auxiliary electrode is not limited to those disks having holes as employed in the foregoing embodiments, and may use various materials such as mesh-like ones. A disk used as the auxiliary electrode is not necessarily provided with the holes for letting the plating solution therethrough" (column 6 lines 6-23). It would have been obvious to one having ordinary skill in the art at the time the invention was made to have modified the method and apparatus of Ueno by modifying the diameter of the shield such that it is greater than the diameter of the anode, because a skilled artisan would be able to determine the appropriate diameter of the shield such that it is greater than the diameter of the anode through routine experimentation in order to provide uniform electroplating, and because modifying the diameter of the shield such that it is greater than the diameter of the anode would allow a larger substrate to be uniformly electroplated. Furthermore, absent any clear evidence of unexpected result, changes in size and proportion is prima facie obviousness (MPEP 2144.04).

In response to the argument that the shield of Ueno cannot be a source of metal ions to be plated, the examiner respectfully disagrees. The shield of Ueno is structurally capable of providing a source of metal ions because it is made of copper which is the same material as that of the instant claim.

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The examiner believes that he has met the requirement for a prima facie case of obviousness.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

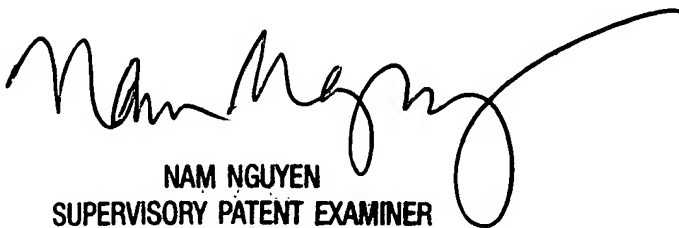
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Luan V. Van whose telephone number is 571-272-8521. The examiner can normally be reached on M-F 9:30-6:00.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on 571-272-1342. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

LVV
May 3, 2006


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